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PANDALUS GURNEYI STIMPSON SYNONYMIZED WITH *PANDALUS DANAE* STIMPSON (DECAPODA: PANDALIDAE)

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Abstract.—*Pandalus gurneyi* Stimpson, 1871 is found to be a junior synonym of *P. danae* Stimpson, 1857. In all features that are supposed to distinguish between the two (number of rostral spines and teeth, length of rostrum/length of carapace, number of carpal articles of the second pereopods, length of scaphocerite/length of rostrum, and length/width of the sixth abdominal segment), there is considerable variability between individuals throughout the range. Specimens from southern California and Baja California tend to have fewer dorsal rostral spines, more ventral rostral teeth and fewer carpal articles than specimens from north of Point Conception, California. Small animals and functional males tend to have proportionally longer rostra than large females. *Pandalus gurneyi* may have been described from a male of *P. danae.*

The coonstripe shrimp, *Pandalus danae* Stimpson, 1857 is one of the most strikingly colored shrimp of low intertidal and shallow subtidal regions in Washington and British Columbia, on the northwestern coast of North America. The animal is marked with brown spots and stripes on a translucent background, with exceptionally vivid banding on the antennae and pereopods. Butler (1980) provided a more detailed description, color notes and illustration of the species. Ricketts et al. (1985) provided natural history notes on the shrimp, as did Kozloff (1973), who also included a black-and-white photograph. The popular books by Cribb (1983) and Rotman & Allen (1983) included color close-up photographs of the species.

Stimpson (1871) also described a second species, *Pandalus gurneyi.* The description consisted of a brief paragraph which stated that the species had a rostrum "more than one-half longer than the carapace" and armed above with 8–9 "teeth" and 9 ventral "teeth." Schmitt (1921) noted that the species was "very near *P. danae,*" and that it differed from *P. danae* in having a rostrum 1.5–1.66 times longer than the carapace, with 8–9 median dorsal movable spines and 9–10 immovable ventral spines. The right second pereopod had 17 carpal segments and the left, the longer of the two, 45 carpal segments. The sixth abdominal segment was 1.5 times as long as wide. (Schmitt used the terms "spines" and "segments" as quoted here, although later authors have called immovable spines "teeth" and carpal segments "carpal articles"). Stimpson's original description noted that the shrimp was "large" and that the "feet of the third pair . . . terminate in well-formed, subcheliform hands."

According to Schmitt, *P. gurneyi* ranged from Monterey to San Pedro and Santa Catalina Island, California, at 17–101 m, while *P. danae* ranged from Sitka, Alaska to San Francisco, California, at 18–186 m. However, Butler (1980) gave the range of *P. danae* south to Point Loma, California, from the intertidal zone to 185 m. There has been little mention of *P. gurneyi* in recent years except for inclusion in species lists or regional guides (Word & Charwat 1976,

Wicksten 1980), but *Pandalus danae* has been trawled off northern California (Wicksten 1984).

Recently, members of the Underwater Photographic Society (Los Angeles and Northern California Chapters) photographed pandalid shrimp in shallow intertidal areas from Monterey Bay south to the coast of Los Angeles and the nearby islands of southern Caifornia. I photographed and collected some of these pandalid shrimp in Monterey Bay, near Pacific Grove, and observed them off the Palos Verdes Peninsula, California. These animals differed in their color pattern slightly from that previously described for *P. danae* in that their stripes were not chocolate brown, but brick red. Their pereopods had bright yellow bands as well as brown and white ones, and the body bore bright blue spots as well as stripes of brown or white. However, Butler (1980) noted variation in the color pattern of *P. danae,* including these color marks.

Do these shrimp from California belong to one or two species of *Pandalus*? I undertook this study to determine which species were present, and whether or not there were consistent differences in color, morphology, range or habitat that could be used to distinguish between *P. danae* and *P. gurneyi.*

Methods

I examined 103 specimens previously identified as *P. danae* or *P. gurneyi,* from localities ranging from Puget Sound, Washington to Bahía San Quintín, Mexico. Specimens were from the collections of the Allan Hancock Foundation, University of Southern California (AHF); National Museum of Natural History (Smithsonian Institution), and Scripps Institution of Oceanography. Stimpson's type specimens no longer are in existence (presumably they were lost during the Chicago fire of 1871). However, I was able to examine specimens identified by W. L. Schmitt. The ratio of rostrum to carapace length, length versus width of the sixth abdominal segment, the number of rostral spines and their placement, the length of the antennal scale and the lengths and number of carpal articles of the second pereopod were reported and compared to determine whether there were any consistent differences between species.

Published photographs were examined to determine if there were any consistent differences in color between shrimp from Washington and British Columbia versus those from California. Color slides were taken by photographers Philip Turner of El off Pacific Grove and at the Monterey Bay Aquarium and Seattle Aquarium. Slides taken by photographers Philip Turner of El Cajón and Ken Howard of San Anselmo, California were examined.

Results

In all features that are supposed to differentiate *P. gurneyi* from *P. danae,* there is considerable overlap. Numbers of dorsal and ventral rostral teeth, rostrum/carapace length ratios, length/width ratios of the sixth abdominal segment, and numbers of carpal articles, are presented in Table 1. In the table, north-central California is defined as between the Oregon border and Point Conception; southern California is the coast south of Point Conception. There is considerable overlap in characters from area to area and between the figures reported for *P. danae* and *P. gurneyi.* As a general rule, the northernmost specimens had more dorsal rostral teeth, southern ones had more ventral teeth; and northern ones had more carpal articles than those to the south. Only a few animals had unusually high numbers of rostral spines or teeth: a single large female had 16 dorsal spines, and three specimens had 10 ventral teeth.

Small animals from southern California had the most variable form of rostrum. The shape ranged from nearly straight to strongly upcurved; the length, from less than the

Table 1.—Comparison of specimens of *Pandalus danae* by locality.

	Washington-Oregon	North-Central California	Southern California–Mexico
Number of dorsal rostral spines	9–13	7–16	7–11
Number of ventral rostral teeth	5–7	5–8	6–10
Average rostral formula	11/6	10/6	9/8
Rostrum/carapace	0.9–1.2	1.0–1.1	0.7–1.7
Length/width of sixth abdominal segment	1.6–2.0	1.2–1.6	1.1–2.0
Number of carpal articles of left second pereopod	57–67	55–60	47–59
Number of carpal articles of right second pereopods	22–27	18–21	15–23

carapace to twice its length. Small animals tended to have relatively larger rostral spines spaced more widely apart than larger animals. However, animals with long, upcurved rostra were found in the same samples as others with straight and shorter rostra, indicating that this variability was due to individual or age-related differences rather than to genetic or habitat-induced causes. Smaller animals also tended to have relatively longer antennal scales (scaphocerites), as long as the carapace, but the ratio of the length of the antennal scale to the carapace length varied from 0.7–1.0 throughout the range of *P. danae*.

As a general rule, coonstriped shrimp from Puget Sound and British Columbian waters had bands of dark chocolate brown on the body and appendages, and only white or translucent bands on the appendages. Shrimp from Monterey Bay and farther south tended to have brick red bands and bands of bright yellow on the appendages, as well as a few bright turquoise blue spots on the body. However, some larger individuals from Monterey Bay were translucent with very dark brown stripes, much like the animals from Puget Sound.

Discussion

The range of variability in all of the features that supposedly differentiate *P. gurneyi* from *P. danae* indicates that they are the same species, and that *P. danae* Stimpson, 1857 should take priority over *P. gurneyi* Stimpson, 1871. Holthuis (1980) noted that *P. franciscorum* Kingsley, 1878 also is a synonym of *P. danae*. In describing *P. gurneyi* as a distinct species, Stimpson probably was not aware that pandalid shrimp are protandrous hermaphrodites. Schmitt (1921) also may have been unaware that *Pandalus* species are sexually dimorphic, because hermaphrodism in *P. danae* was first described by Berkeley (1929). Butler (1980) noted that in male carideans, the rostrum generally is longer in proportion to the body than in females. In protandrous hermaphrodites, males also are smaller than females. It is noteworthy that two of Schmitt's specimens of *P. gurneyi* are functional males, with characteristic prehensile dactyls of the third pereopods (Butler 1980, fig. 4C) and flap-like endopods of the first pleopods. Stimpson's mention of "subcheliform hands of the third pair of legs" suggests that he also examined a male, although he did not indicate the sex of the specimen.

Differences in the numbers of rostral teeth and proportions of the body in *P. danae* may be due to changing water temperatures from the north to the south, or perhaps to genetic differences between populations within the species. Unlike the "geminate" species *Lebbeus catalepis* Jensen, of Puget Sound, and *L. lagunae* (Schmitt) of Monterey–Baja California, *P. danae* has a continuous geographic range along the entire

coast from Alaska to Baja California, including Oregon and northern California.

The cause of color differences observed in coonstriped shrimp is unknown, but may be related to diet, age, sex or habitat. Large animals usually are caught on coarse sand and gravel, but small ones can venture into eelgrass flats, docks, pilings, and cracks in rocky reefs. The shrimp can be found intertidally as far south as Bodega Bay, California (USC unpubl. field notes). Farther south, they live subtidally among cracks and rocks among kelp beds and breakwaters and on coarse sandy areas near reefs.

Examination of the specimens indicates that *Pandalus danae* extends south to the northwestern coast of Baja California, Mexico. The southernmost record to date is off Bahía San Quintín, Baja California Norte (30°20′N, 115°57′W), 41 m, 17 Oct 1971, R/V *Searcher* station 226, two specimens, AHF.

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